What is claimed is:

1. A method for receiving a multi-dimensional high-speed signal comprised of a plurality of bits, via a modem, comprising steps of:

receiving a channel output having a plurality of bits where each bit is sent in a particular dimension;

mixing signals of the received channel output with trigonometric signals;

retrieving bits in each of the particular dimensions by:

demodulating the mixed signals in an orthogonal filter bank of low pass Eigen filters defined by a transmitted prolate pulse of the channel output;

reverse mapping the demodulated mixed signal to recover segmented bits; and

reconstructing an originally transmitted bit pattern to recreate an original signal.

2. The method of claim 1, comprising steps of:

with a signal comprising I_k, and Q_k values, demodulating the signal and reverse mapping the demodulated signal in parallel paths to reconstruct an original transmitted block of bits at a termination of the parallel paths.

3. A high-speed receiver for receiving a multi-dimensional high-speed signal comprised of a plurality of bits, via a modem, comprising:

an input for receiving a channel output signal having a spectral distribution defined by a prolate pulse;

mixing circuitry connected to apply trigonometric mixing signals to the channel output signal;

demodulation circuitry including a plurality of orthogonal filter banks of low pass eigen filters defined by a transmitted prolate pulse of the channel output; and

reverse mapping circuitry connected for reconstructing an originally transmitted bit pattern to recreate an original signal.

4. The high speed receiver of claim 3, further comprising:

a plurality of parallel paths, each connected to the input and each path including a mixer circuit and an Eigen filter; and

each path connected to a packet reconstruction circuit.

5. A method of high-speed communications for achieving high spectral efficiency comprising steps of:

dividing a transmission channel into a plurality of sub channels;

modulating signals in each sub channel in a numbered plurality of sub transmitters using discrete prolate functions for capacity optimization;

summing the modulated signals and transmitting the summed signals through a transmission channel subject to noise;

recovering the individual channels in a plurality of receivers corresponding to the plurality of sub channels; and reconstructing original bits of the transmission channel by demodulation techniques.

6. The method of claim 5, comprising steps of:

reconstructing the original bits includes filtering in low pass Eigen filters.

7. The method of claim 6, comprising steps of:

reverse mapping to recover segmented bits of an originally transmitted bit pattern of the high-speed input signal.

8. A transmission system for optimizing capacity by achieving high spectral efficiency, comprising:

a plurality of sub transmitters to modulate sub bands of a channel to be transmitted and achieve high spectral efficiency by basing pulse shapes on a prolate pulse;

a summer for combining modulated signal outputs of the plurality of sub transmitters;

a transmission path connected to transmit an output of the summer and subject to noise interference;

a plurality of sub channel receivers connected to the transmission path, each having:

demodulation circuitry connected to demodulate each sub channel;

circuitry to recover bits of each sub channel; and

circuitry to reconstruct an original transmitted signal.

9. A method of data transmission and reception over a transmission channel at high spectral efficiency, comprising steps of:

segmenting the transmission channel into a plurality of sub channels;

allocating bits of the data transmission to the sub channels based on the existing noise distribution;

segmenting of bits in each of the sub channels to orthogonal prolate pulses;

generating symbols from the prolate pulses and modulating the symbols;

transmitting the symbols in a transmission channel connected to a receiving mechanism;

demodulating received signals of each sub channel at the receiving mechanism;

filtering the demodulated symbols to recover transmitted symbols;

recreating an original data signal by mapping the recovered symbols into bits; and

reconstructing the originally transmitted data from the mapped bits.

10. The method of claim 9, including the step of:

constructing the data transmission to be transmitted over a transmission channel with a form according to

$$x_i(t) = \sum_{k=-\infty}^{\infty} I_k p_i(t-kT).$$

11. The method of claim 10, including the step of:

constructing the data transmission to be transmitted over a transmssion channel within a form according to

$$y_i(t) = \sum_{k=-\infty}^{\infty} Q_k p_i(t-kT).$$

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13. The method of claim 9, including the step of:

allocating bits includes inserting signal data into bins bounded by a bottom limiting noise threshold level and an upper limiting energy limit.

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14. The method of claim 13, including the step of:

controlling signaling power S according to

$$S = \int_{f \in \Omega} B - \frac{N(f)}{|H(f)|^2} df$$

where a region of integration Ω is defined by

$$\Omega = \left\{ f : \frac{N(f)}{|H(f)|^2} \leq B \right\}.$$

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15. The method of claim 14, wherein the step of:

segmenting bits includes utilizing multiple discrete prolate pulse functions.

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16. A transmitter for data transmission over a transmission channel at high spectral efficiency, comprising:

means for segmenting the transmission channel into a plurality of sub channels,

means for allocating bits of the data transmission to the sub channels based on existing noise distribution;

transmitting circuitry in each sub channel including:

means for segmenting the bits in each sub channel to orthogonal prolate pulses;

means for generating symbols from the prolate pulses; and

means for transmitting the symbols in a transmission channel.